

STORMWATER TREATMENT AREAS

STORMWATER TREATMENT AREA 1 WEST

SUMMARY

MAP

Background

Stormwater Treatment Area 1 West (STA-1W) encompasses the four treatment cells of the Everglades Nutrient Removal Project (ENR) plus the newly constructed treatment Cell 5 creating a total effective treatment area of 6,870 acres. The permit for the ENR expired at the end of April 1999. The STA-1W permit went into effect May 11, 1999. Cell 5 passed the start-up phase of operation for both phosphorus and mercury during the week of January 17, 2000.

In accordance with construction plans, the inflows to STA-1W were diverted July 12, 1999, from pump station G-250 to inflow structure G-302, a component of the new Inflow and Distribution Works for STAs-1W and 1E. As a result of the diversion, pump station S5A became the inflow monitoring station for STA-1W. The outflow site (G251) from the ENR permit remains the same for the STA1W. A new outflow pump station, G310, began operation on July 5, 2000, predominantly discharging flow from Cell 5.

Phosphorus Loads and Concentrations

Total phosphorus loads for STA-1W were reduced by 88 percent in October Load reductions for November and December could not be calculated due to no inflows (**Figure 11A**). During October 12.9 metric tons of total phosphorus entered STA-1W through S5A compared to 0.2 and 1.28 metric tons discharged from G251 and G-310, respectively (**Figure 11B**).

The October average flow-weighted (FWM) total phosphorus concentration for S5A was 187. ppb (**Figure 12**). The flow-weighted mean concentrations in the outflows in October were 20 ppb for G-251 and 82 ppb for G310. G-310 had a 28 ppb flow-weighted mean discharge concentrations for November.

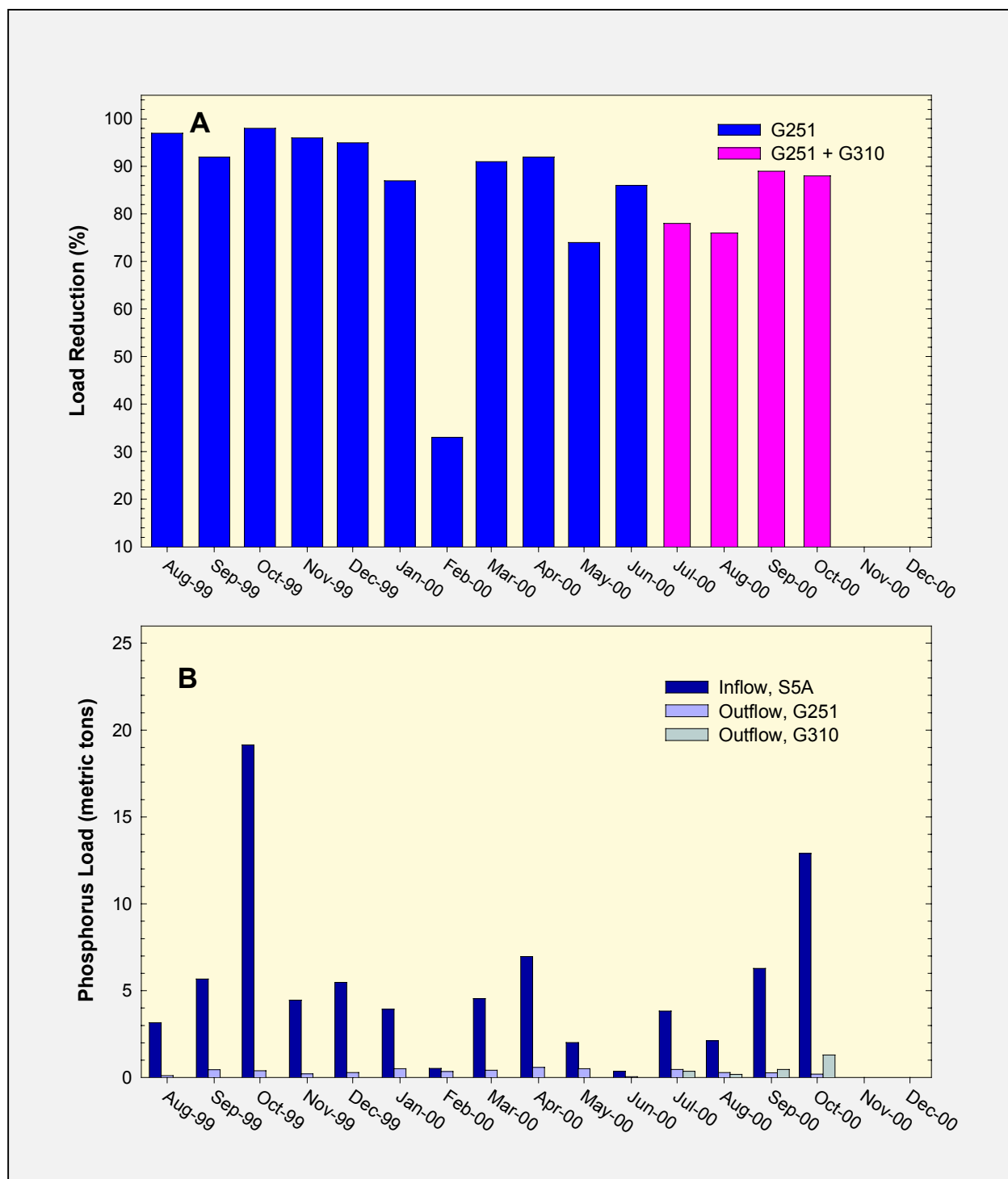


Figure 11. a. Monthly percent reduction of total phosphorus in STA-1W.
b. Monthly total phosphorus loads at inflow and outflow sites of STA-1W.

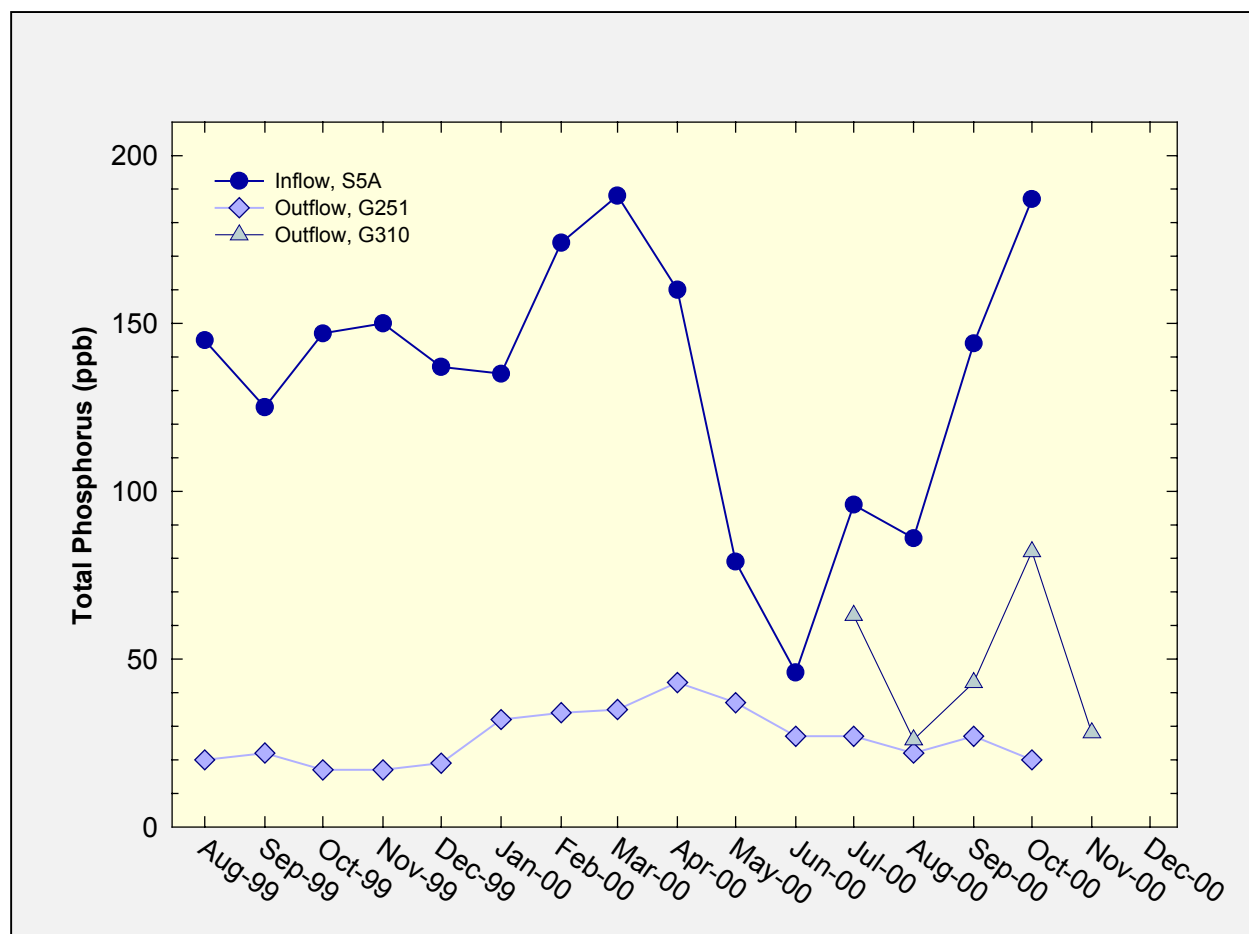


Figure 12. Monthly flow-weighted mean total phosphorus concentrations at inflow and outflow sites of STA-1W.

Mercury Monitoring

The STA permits require the District to collect unfiltered water samples quarterly at inflows and outflows for analysis of total mercury (THg) and methylmercury (MeHg). The permits also require the District to collect between 100 and 250 mosquitofish (*Gambusia holbrooki*) semiannually and 20 largemouth bass (*Micropterus salmoides*) annually from the inflow, interior marshes and outflows for mercury analysis. Individual mosquitofish are pooled to form composite samples for each location. In 2000, sunfish (*Lepomis spp.*) were added to this monitoring program to better evaluate mercury exposure to fish-eating birds. Monitoring mercury concentrations in aquatic animals provides several advantages. First, MeHg occurs at much greater concentrations in biota (animal and plant life) relative to surrounding water, making chemical analysis more accurate and precise. Although detection levels of part per trillion (ppt or ng/L) have been achieved for total mercury and methylmercury in water, uncertainty boundaries can become large when ambient concentrations are very low, as is often the case in the Everglades. Second, organisms integrate exposure to mercury over space and time. Since mosquitofish are short-lived, they can be used to monitor short-term changes in environmental concentrations of mercury through time. Largemouth bass and sunfish are long-lived species and represent average conditions that occurred over previous years. Finally, the mercury concentration in biota is a true measure of MeHg bioavailability and is therefore a better indicator of possible mercury exposure to fish-eating wildlife than the aqueous concentration of mercury in surface water.

Mercury Levels STA-1W

Routine monitoring of mercury concentrations at STA-1W began February 16, 2000. Surface water samples for the third quarter of 2000 were collected August 22. At that time, construction of the second outflow pump, G310, had been completed. Total mercury concentration was 2.6 ng/L at the inflow and 2.3 ng/L at the two outflows (G251 and G310). While concentrations of total mercury were slightly elevated compared to the first two quarters (**Figure 13a**), they were within the typical range previously measured in this area when it was operated as the Everglades Nutrient Removal Project. Total mercury concentrations were lower at the outflows compared to the inflow and were below Florida's Class III Water Quality Standard of 12 ng/L. Methylmercury concentration was 0.46 ng/L at the inflow and 0.61 (G251) and 0.12 (G310) ng/L at the two outflows (**Figure 13b**). Methylmercury concentration at the G251 outflow was greater than the concentration observed at the inflow and was at the extreme range of levels previously measured during operation of the ENR project. While the level of methylmercury at G251 warrants continued scrutiny, it does not represent an anomalously high

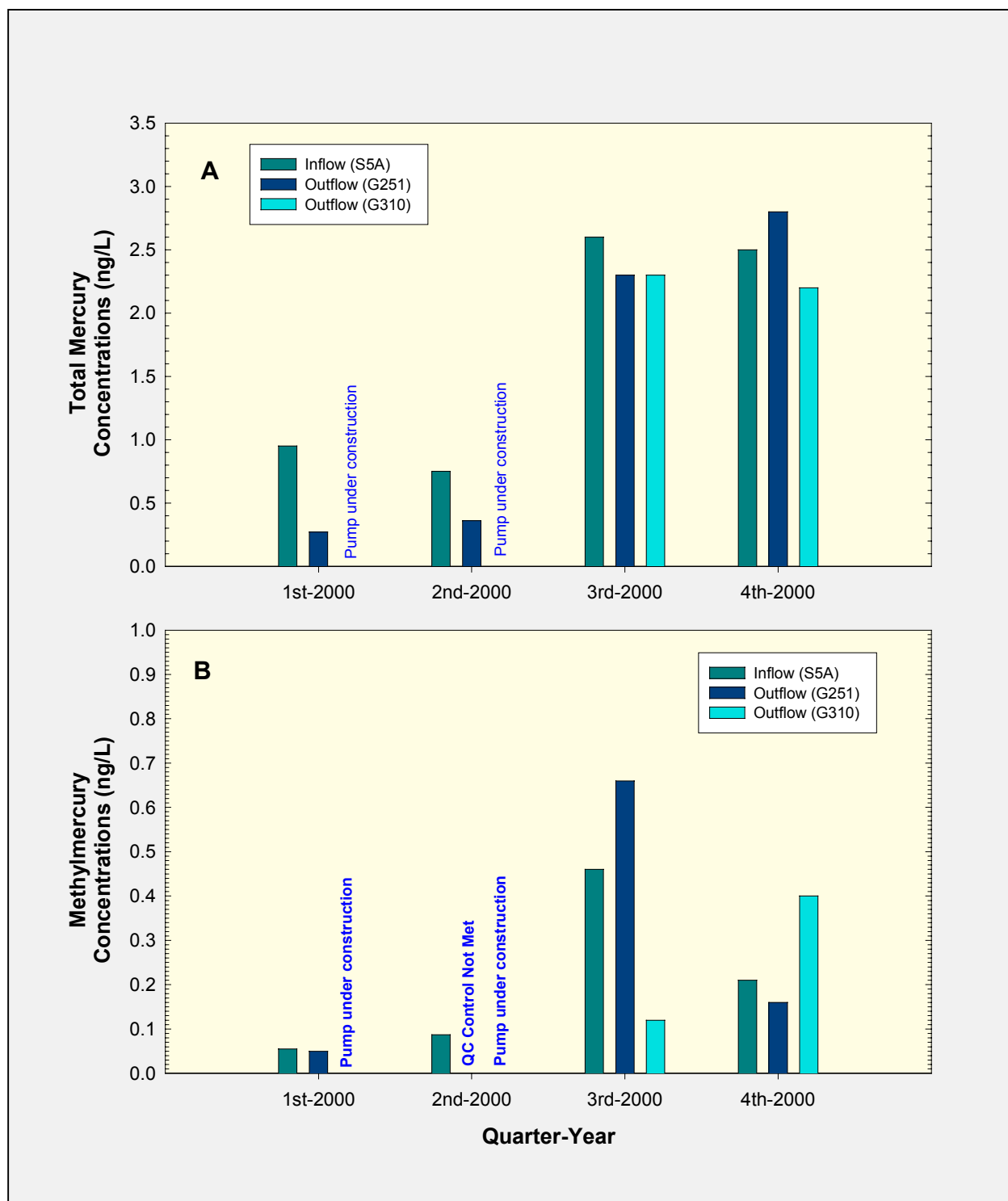


Figure 13. a. Quarterly surface water total mercury concentrations at inflow and outflow sites of STA-1W. b. Quarterly surface water methylmercury concentrations at inflow and outflow sites of STA-1W.

value when compared to concentrations observed at other locations in south Florida, including other STAs.

Results from the annual collections of largemouth bass and sunfish are reported in the [*2001 Everglades Consolidated Report*](#) (SFWMD, 2001). Results from the first semiannual collection of mosquitofish (**Figure 14**), were first reported in the October 2000 Environmental Conditions Update Report. As previously stated, concentrations of mercury in fish tissues were well below guidance levels suggested by both the U.S. Fish and Wildlife Service (USFWS; 100 ng/g) and the U.S. Environmental Protection Agency (U.S. EPA; 77 ng/g) for the protection of fish-eating avian and mammalian wildlife.

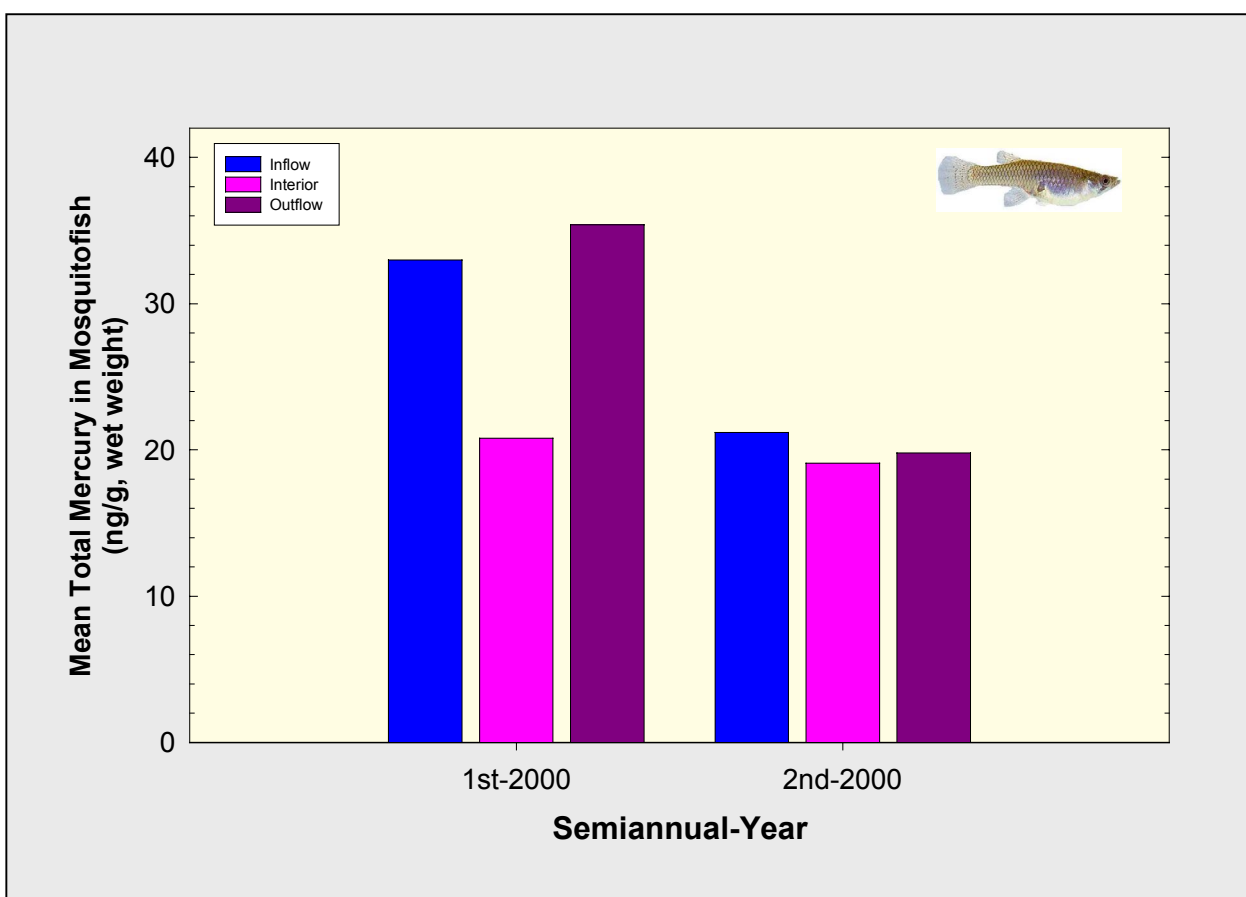


Figure 14. Mean total mercury concentrations in mosquitofish collected at the inflow, interior and outflow of STA-1W.

STORMWATER TREATMENT AREA 5

SUMMARY

MAP

Background

Stormwater Treatment Area 5 (STA-5) began flow-through operation on July 7, 2000. STA-5 has an approximate treatment area of 4,118 acres, which was previously agricultural cropland. STA-5 receives untreated runoff from the C-139 Basin via the L2 canal and discharges treated water to the Miami Canal.

Phosphorus Concentrations

For October 2000, the flow-weighted mean total phosphorus concentration at the four inflow sites (G-342A-D) averaged 323 ppb. For November the concentration was 88 ppb. At the four outflow sites (G-344A-D) the flow-weighted mean averaged 81 ppb for October. The November outflow-weighted mean and the inflow and outflow-weighted means for December could not be calculated due to negligible flows (**Figures 15**).

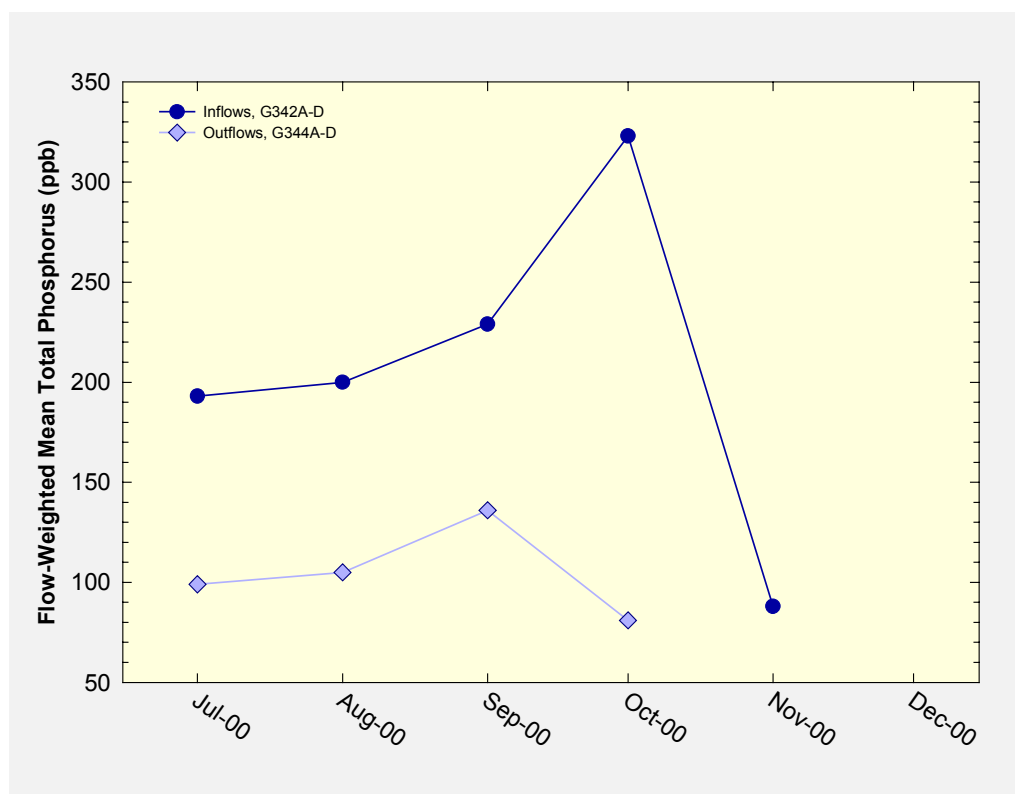


Figure 15. Monthly flow-weighted mean total phosphorus concentrations at inflow and outflow sites of STA-5.

Phosphorus Loads

The October total phosphorus inflow and outflow loads for STA-5 were 5.5 and 29 metric tons, respectively., resulting in a 47 percent load reduction (**Figure 16a**). The total phosphorus inflow load was 0.1 metric tons for November. The outflow load for November and the inflow and outflow loads for December could not be calculated due to negligible flows (**Figure 16b**).

Mercury Levels STA-5

Routine monitoring of mercury levels at STA-5 began during the first quarter of 2000. Surface water samples for the fourth quarter of 2000 were collected on December 13. At that time, average THg concentration was 1.03 ± 0.1 at the four inflows and 2.4 ± 1.3 ng/L at the four outflows (**Figure 17a**). (average ± 1 standard deviation; *standard deviation measures the variability or dispersion of data around the mean. A small standard deviation implies that the data are clustered around the mean. For a normal distribution, about 95 percent of the observations should lie within two standard deviations of the mean*). Methylmercury (MeHg) concentration at the inflows and outflows were 0.5 ± 0.3 and 1.5 ± 1.1 ng/L, respectively (**Figure 17b**). Both THg and MeHg were at greater concentration in the outflows compared to the inflows. Elevated levels centered near discharge culverts G344A and G344B from Treatment Train 1. As will be discussed below, mosquitofish from this treatment train also contained higher levels of THg relative to mosquitofish collected elsewhere. Nevertheless, THg concentration remained below the Class III Water Quality Standard of 12 ng/L.

The first semi-annual collection of mosquitofish occurred in March of 2000. The second semi-annual collection occurred on September 7. At that time, average tissue mercury concentration was 35.5 ± 9.1 ng/g (on a wet weight basis) in mosquitofish collected near the inflows, 97 ± 40.9 ng/g in mosquitofish from interior marshes and, 47.9 ± 4.9 ng/g in mosquitofish from the Discharge Canal near the outflows (**Figure 18**). As mentioned above, mercury levels were highest in mosquitofish from Cell 1 (126 ng/g), which also exhibited elevated surface water concentrations. Concentration of mercury in mosquitofish from Cell 1 exceeded guidance levels suggested by both the U.S. Fish and Wildlife Service (USFWS; 100 ng/g) and the U.S. Environmental Protection Agency (U.S. EPA; 77 ng/g) for the protection of fish eating avian and mammalian wildlife. The factor or factors that lead to these spatial differences are as-yet

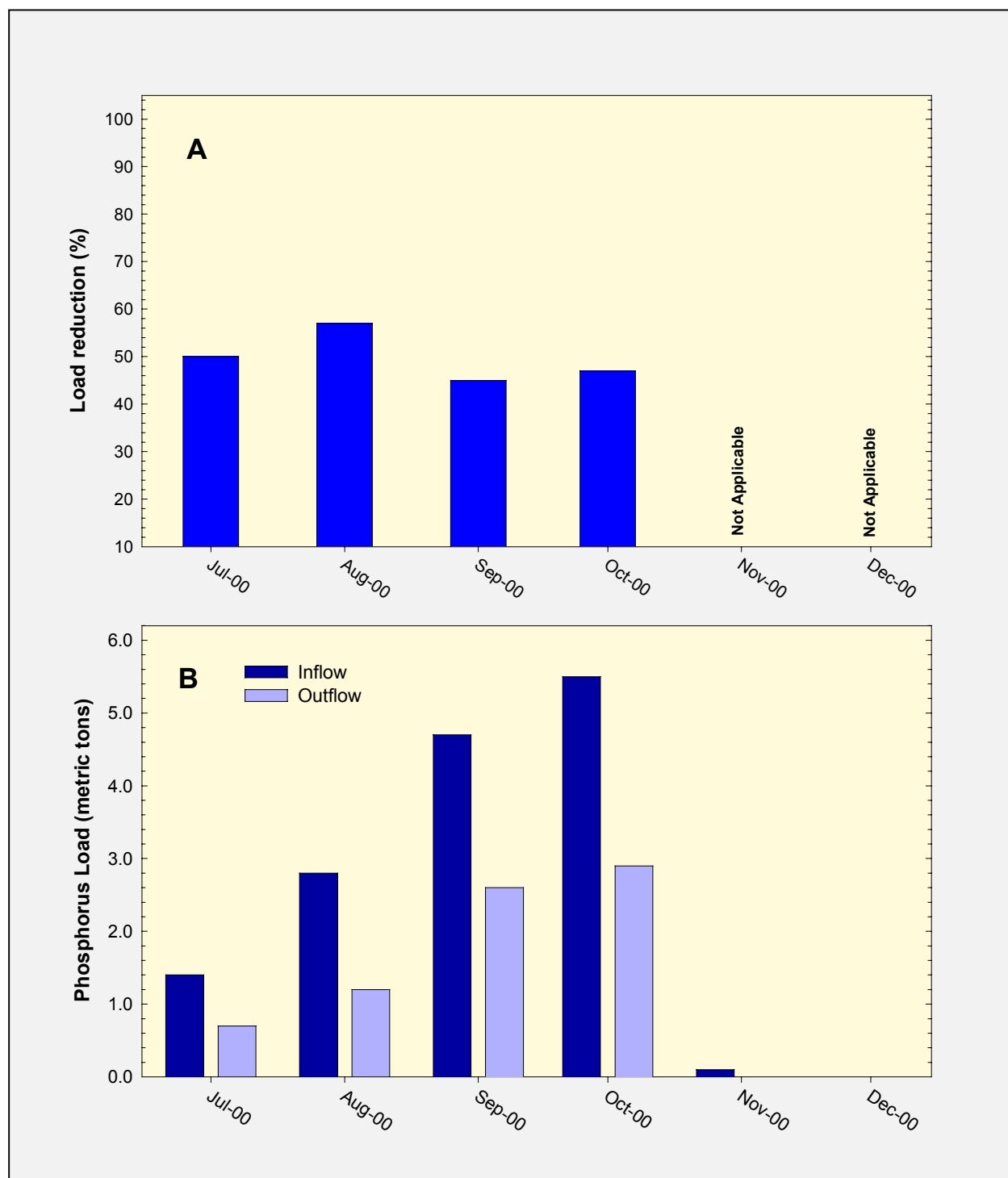


Figure 16. a. Monthly percent reduction of total phosphorus in STA-5.
b. Monthly total phosphorus loads at inflow and outflow sites of STA-5.

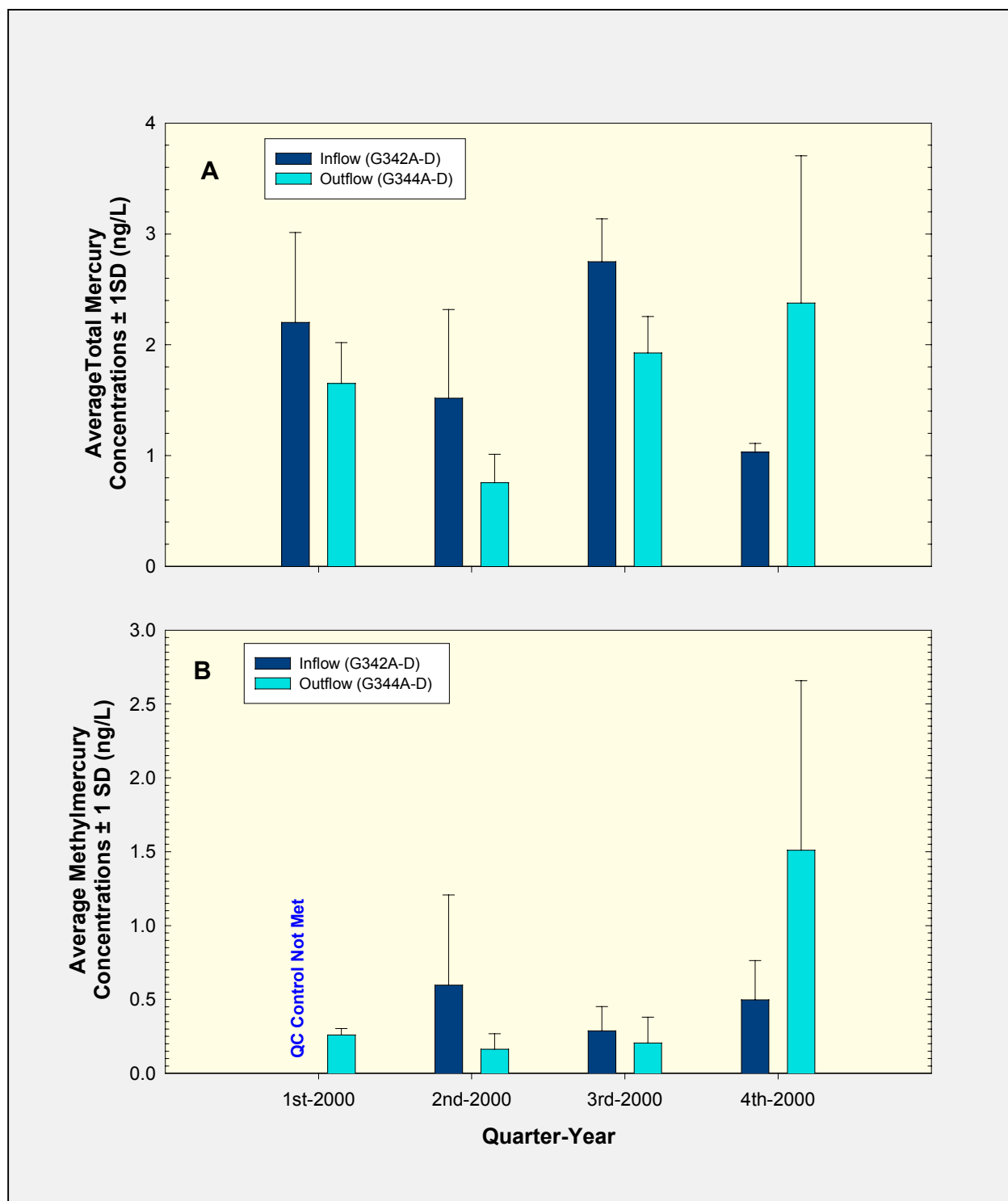


Figure 17. **a.** Quarterly surface water total mercury concentrations at inflow and outflow sites of STA-5. **b.** Quarterly surface water methylmercury concentrations at inflow and outflow sites of STA-5. (Error bars depict one standard deviation around the mean.)

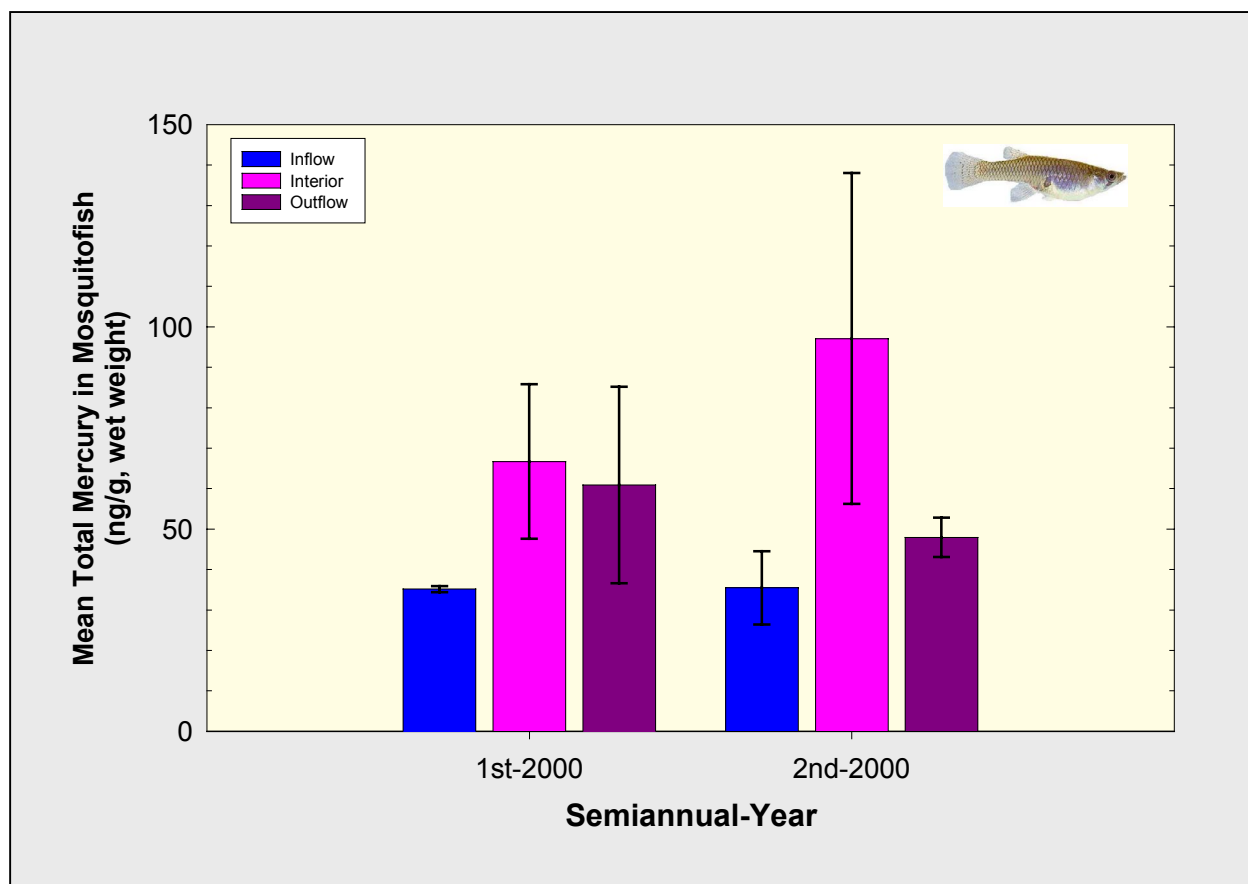


Figure 18. Mean total mercury concentrations in mosquitofish collected at the inflow, Interior and outflow of STA-5. (Error bars depict standard deviation around the mean.)

unknown. However, it important to note that mosquitofish in the discharge canal contained relatively low levels despite the elevated MeHg in surface water discharges. Local bioaccumulation of mercury is primarily determined by *in situ* methylation and biomagnification of MeHg up the food chain rather than by inputs of MeHg dissolved in the water column.

For more information about STA mercury monitoring permit requirements, please [click here](#).

STORMWATER TREATMENT AREA 6

SUMMARY

MAP

Background

Stormwater Treatment Area 6 (STA-6), Section 1, began full operation December 9, 1997. It occupies an existing detention area associated with United States Sugar Corp.'s (USSC) Southern Division Ranch, Unit 2 development, except for 1 acre that is within the adjacent Rotenberger Tract. STA-6 provides a total effective treatment area of approximately 870 acres. The source of water for STA-6 comes solely from USSC's Unit 2 pump station G600.

Phosphorus Concentrations

For the fourth quarter of 2000, the flow-weighted mean total phosphorus concentrations at the inflow averaged 119 ppb and 32 ppb at the outflow (October and November only). The average flow-weighted mean total phosphorus concentration for the period of record at the outflow is 21 ppb, or 3 times lower than the average inflow concentration (**Figure 19a**).

Phosphorus Loads

Loads from the fourth quarter of 2000 were 3.8 metric tons at the inflow, and 0.4 metric tons at the outflow (October and November only) (**Figure 19b**). The total phosphorus load reduction for the fourth quarter of 2000 was 89 percent. The overall total phosphorus load has been reduced by 81 percent since the operation began.

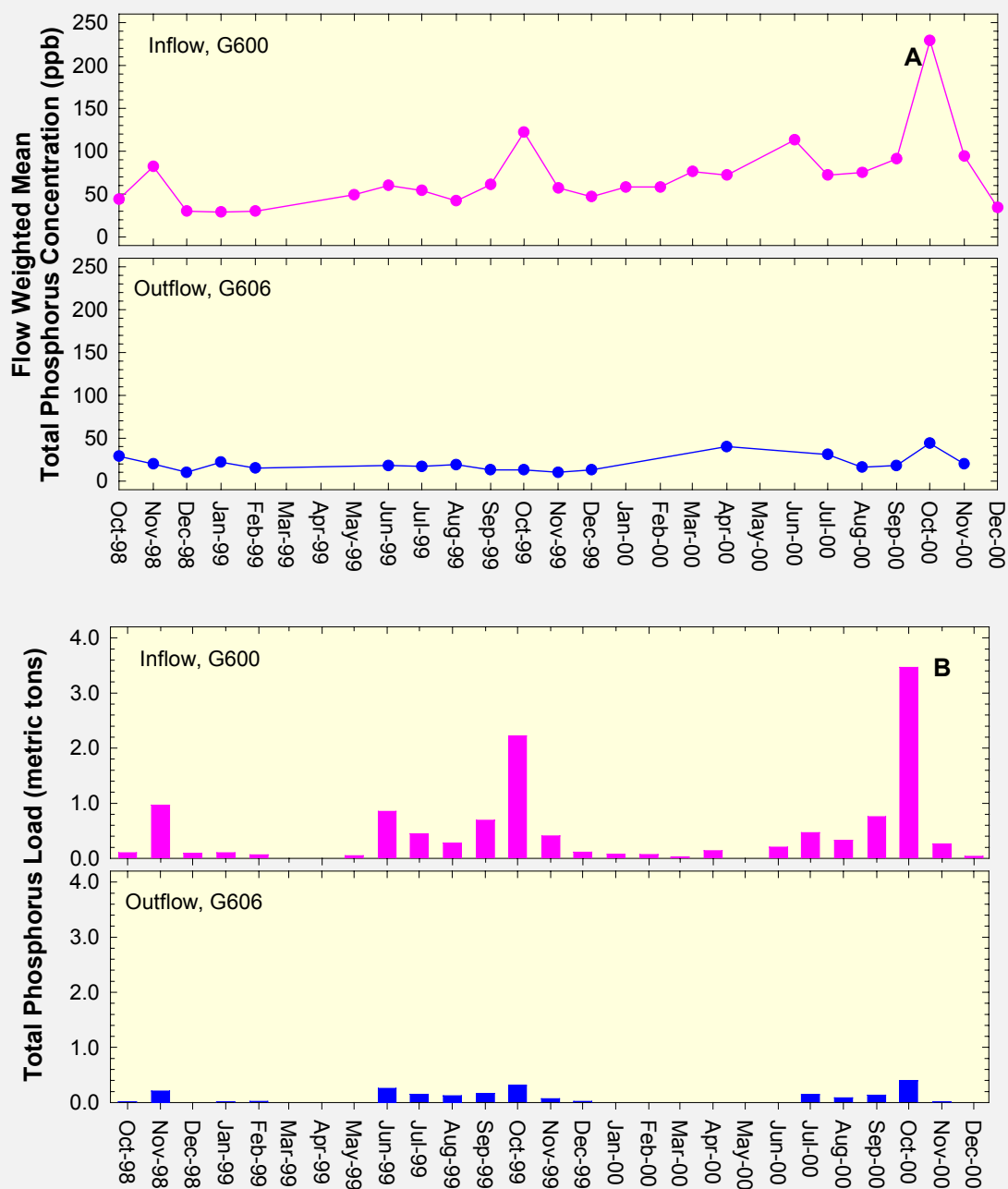


Figure 19. **a.** Weekly flow-weighted mean total phosphorus concentrations at inflow and outflow sites of STA-6, Section 1.
b. Monthly total phosphorus load at inflow and outflow sites of STA-6, Section 1.

Mercury Levels STA-6

Routine monitoring of mercury levels at STA 6 began in the first quarter of 1998. Surface water samples for the fourth quarter of 2000 were collected on December 6. At that time, THg concentrations at the inflow (G600) and the outflow (G606) were 2.6 and 2.3 ng/L, respectively (**Figure 20a**). Concentration of THg was greater at the inflow than the outflow. Moreover, concentrations of THg, both at the inflow and the outflow, remained below the Florida's Class III Water Quality Standard of 12 ng/L. MeHg concentrations at the inflow and the outflow were 0.25 and 0.43 ng/L, respectively (**Figure 20b**); however, the result for the outflow did not meet quality control criteria and, thus, is an estimate only. In addition to monitoring surface water at G606, samples were also collected at outflow culverts of each cell in December to examine spatial variability and representativeness of G606. Concentrations of THg were 2.3 ng/L and 2.0 ng/L at G393B and G354C, respectively. Concentrations of MeHg were 0.22 ng/L and 0.13 ng/L at G393B and G354C, respectively; however, the latter result again did not meet QC criteria. Nonetheless, it is clear that both THg and MeHg were at lower concentrations at the outflow culvert than in the Supply Canal (i.e., G600) or the Discharge Canal (i.e., G606).

Results from the annual collections of largemouth bass and sunfish are reported in the District's *2001 Everglades Consolidated Report, Chapter 7*. Mosquitofish were first collected at STA-6 in early 1998. Results from the first semi-annual collection of mosquitofish in 2000 (**Figure 21**), were first reported in the October 2000 Environmental Conditions Update Report. As previously stated, levels of mercury in mosquitofish from the inflow and outflow approached or just exceeded guidance levels suggested by the U.S. Fish and Wildlife Service (USFWS; 100 ng/g) and the U.S. Environmental Protection Agency (U.S. EPA; 77 ng/g) for the protection of fish-eating avian and mammalian wildlife. However, because there had been no appreciable discharge from STA 6 for six months, the mosquitofish in the Discharge Canal did not reflect flow from the STA and, thus, did not accurately reflect typical operation of the STA.

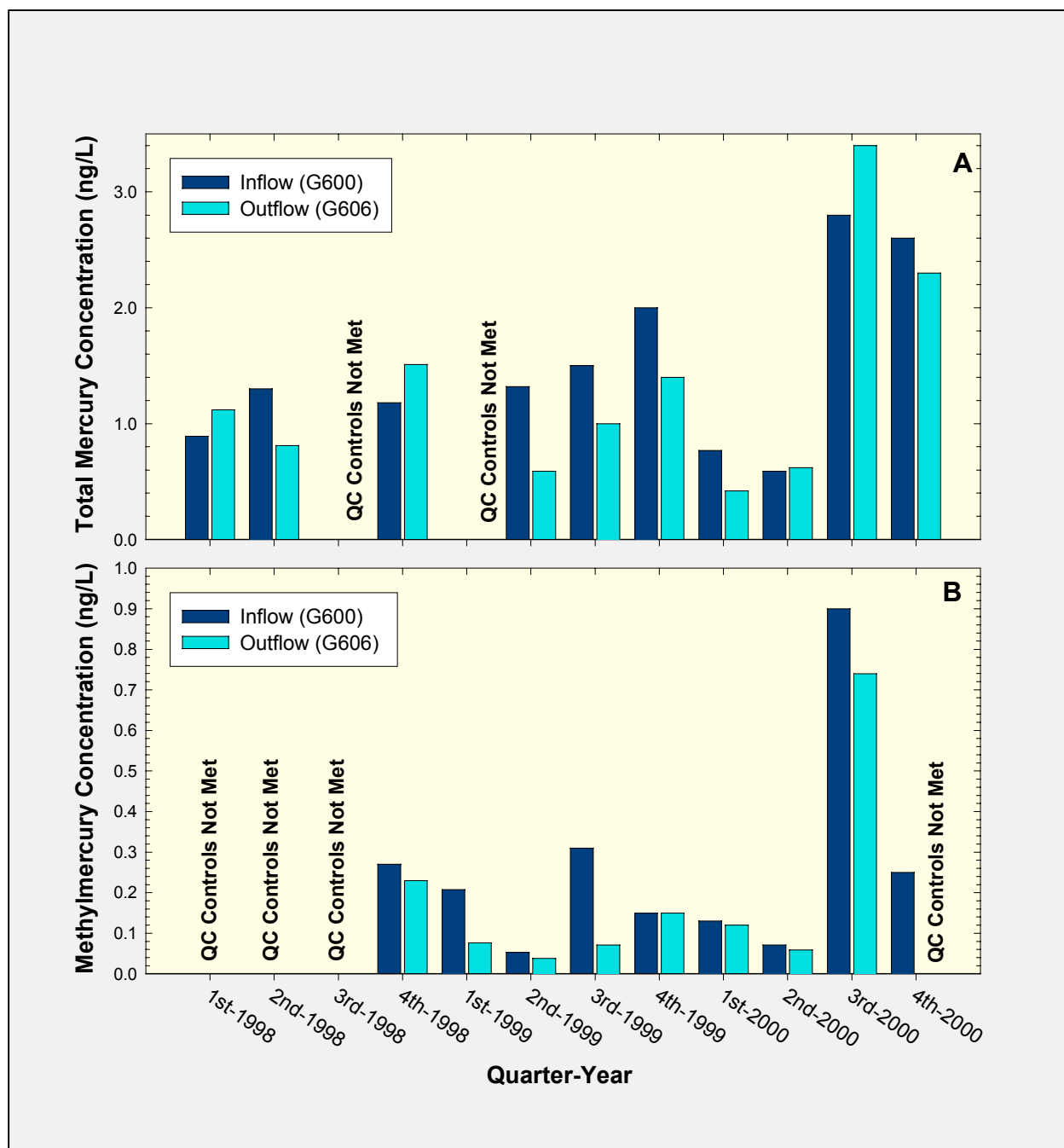


Figure 20. **a.** Quarterly surface water total mercury concentrations at inflow and outflow sites of STA-6. **b.** Quarterly surface water methylmercury concentrations inflow and outflow sites of STA-6.

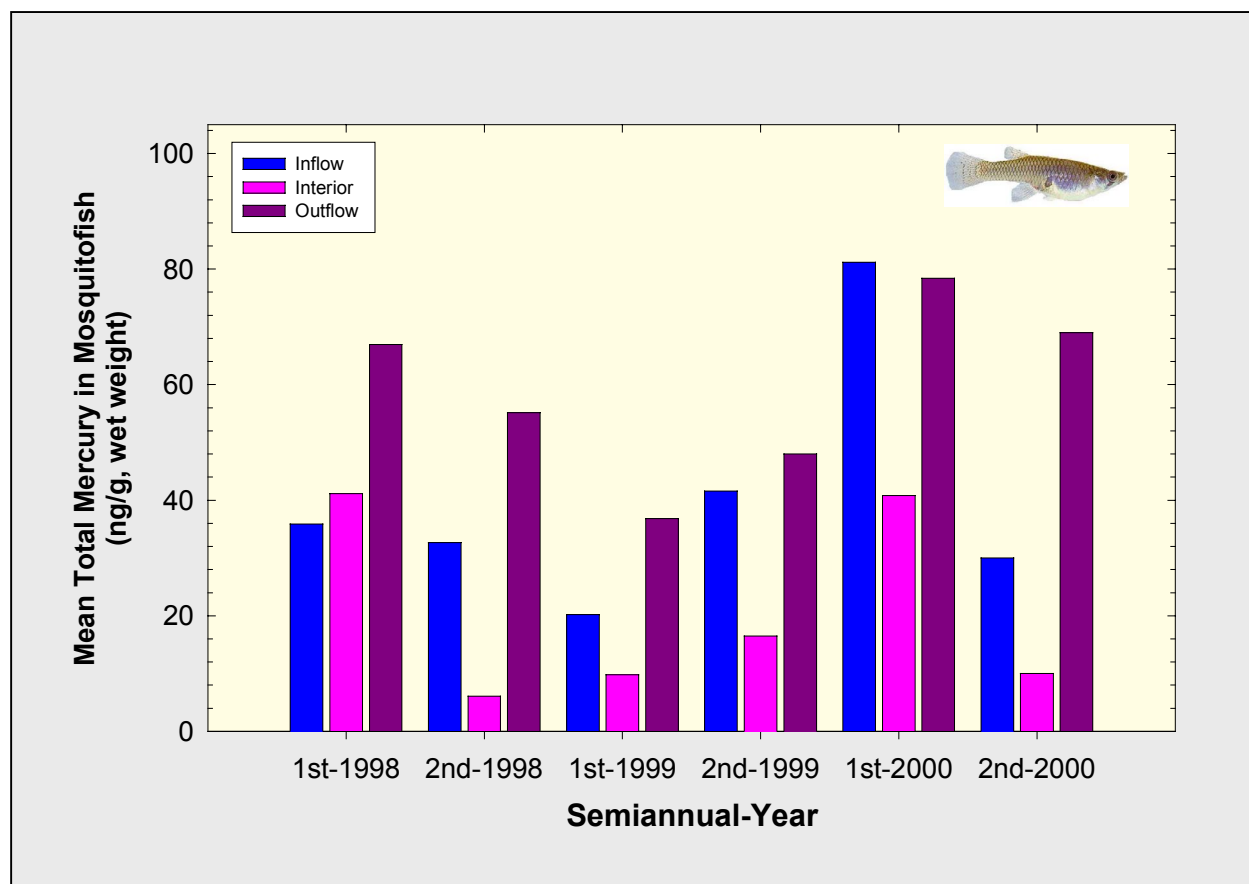


Figure 21. Mean total mercury concentrations in mosquitofish collected at the inflow, interior and outflow of STA-6.